

PTO 08-4280

CC=CN DATE=20030430 KIND=A  
PN=1413797

AN EXPANSION BLAZE WELDING METHOD OF ALUMINUM COPPER TUBING, AN ACTIVE  
BONDING AGENT FOR SAID METHOD, AND THE PREPARATION METHOD THEREOF  
[Lv Tong Guan de Peng Zhang Qian Han Fa ji Yong Yu Gai Fa de Huo Xing  
Lian Jie Ji ji qi Zhi Fa]

PENG HE, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE  
Washington, D.C. April 2008

Translated by: FLS, Inc.

PUBLICATION COUNTRY (19) : CN

DOCUMENT NUMBER (11) : 1413797

DOCUMENT KIND (12) : A

PUBLICATION DATE (43) : 20030430

APPLICATION NUMBER (21) : 02133238X

DATE OF FILING (22) : 20021021

ADDITION TO (61) : NA

INTERNATIONAL CLASSIFICATION (51) : B23K 35/362, B23K 31/12

PRIORITY (30) : NA

INVENTORS (72) : HE, PENG; FENG, JICAI; QIAN, YIYU;  
LI, ZHENRAN; HAN, JIECAI

APPLICANT (71) : HARBIN INSTITUE OF TECHNOLOGY

DESIGNATED CONTRACTING STATES (81) : NA

TITLE (54) : AN EXPANSION BLAZE WELDING METHOD  
OF ALUMINUM COPPER TUBING, AN  
ACTIVE BONDING AGENT FOR SAID  
METHOD, AND THE PREPARATION METHOD  
THEREOF

FOREIGN TITLE [54A] : LV TONG GUAN DE PENG ZHANG QIAN HAN  
FA JI YONG YU GAI FA DE HUO XING  
LIAN JIE JI JI QI ZHI FA

[Claim 1] An active bonding agent without blazing filler material, wherein it is characterized by it comprising the following components: an activated nanopowder, a non-corrosive flux, and a binder. The weight ratio relationship between each of the components is: binder : non-corrosive flux : activated nanopowder = (1 - 20) : (1 - 5) : (0 - 1).

[Claim 2] An active bonding agent without blazing filler material as described in Claim 1 of the patent application claims, wherein it is characterized by the purity of the activated nanopowder being 99.9% - 100% and the granularity being 20 nm - 100 µm.

[Claim 3] An active bonding agent without blazing filler material as described in Claim 1 of the patent application claims, wherein it is characterized by the binder being comprised of water and organic cellulose, and the weight ratio of the water and the organic cellulose is 100 : (0.1 - 5).

[Claim 4] An active bonding agent without blazing filler material as described in Claim 1 of the patent application claims, wherein it is characterized by the purity of the activated nanopowder being 99.92% - 99.98% and the granularity being 20 nm - 10 µm.

[Claim 5] A preparation method for an active bonding agent without blazing filler material, wherein it is characterized by activated granules with a purity of 99.9% - 100% being mechanically smashed to form a nanopowder with a granularity of 20 nm - 100 µm. A binder is composed

---

\*Numbers in the margin indicate pagination in the foreign text.

of water and organic cellulose. The weight ratio of the water and organic cellulose is 100 : (0.1 - 5). Mix the aforementioned two components with a non-corrosive flux according to the following weight ratio relationship: binder : non-corrosive flux : activated nanopowder = (1 - 5) : (1 - 20) : (0 - 1) to form an active bonding agent without blazing filler material.

[Claim 6] An expansion blaze welding method for aluminum copper piping, wherein it is characterized by first processing the connector of the aluminum pipe (1) and copper pipe (2) into a cone surface (3). The blaze welding surface of the cone (3) of the aluminum pipe (1) and copper pipe (2) connector is coated with an active bonding agent without blazing filler material (4). It is then heated according to the blaze welding temperature of the specification. During the process of heating, a pressure of P is applied to the two ends of the two welding pipes so that a tight connection is maintained throughout, during the blaze welding process between the aluminum pipe (1) and copper pipe (2) to complete the rapid blaze welding process.

[Claim 7] An expansion blaze welding method for aluminum copper piping as described in Claim 6 of the patent application claims, wherein it is characterized by processing the blaze welding surface (3) of connector of the aluminum pipe (1) and copper pipe (2) into a single cone (3-1) so that the aluminum pipe (1) is on the outside and the copper pipe (2) is on the inside.

[Claim 8] An expansion blaze welding method for aluminum copper piping as described in Claim 6 of the patent application claims, wherein it is

characterized by processing the blaze welding surface (3) into double cones (3-2).

[Claim 9] An expansion blaze welding method for aluminum copper piping as described in Claim 6 of the patent application claims, wherein it is characterized by when the aluminum pipe (1) is inserted inside the copper pipe (2), the aluminum pipe (1) and copper pipe (2) connectors are not processed into cones and are directly blaze welded.

[Claim 10] A blaze welding method for aluminum copper piping as described in Claim 9 of the patent application claims, wherein it is characterized by contracting pipe processing is performed on the copper pipe (2) after they are connected, and then it is blaze welded.

[Detailed Description of the Invention]

/3

AN EXPANSION BLAZE WELDING METHOD OF ALUMINUM COPPER TUBING, AN ACTIVE BONDING AGENT FOR SAID METHOD, AND THE PREPARATION METHOD THEREOF

[Technical Field of the Invention]

The present invention involves a blaze welding connection method for aluminum copper tubing. Specifically it involves a rapid blaze welding method for aluminum and copper pipes that doesn't contain blazing filler material and is non-corrosive. Whereby an active bonding agent without blazing filler material is used for this method and a preparation method of said active bonding agent is provided.

[Prior Art]

The air conditioning industry currently heavily uses large amounts of copper tubing in related products, which makes it difficult to reduce

the costs of such products. One target for several years has been the use of aluminum to replace copper. Because the specific weight of aluminum alloy is  $2.7 \text{ g/cm}^3$  and the specific weight of brass is  $8.5 \text{ g/cm}^3$ , thus replacing copper with aluminum will effectively reduce the weight and cost of the product. However, aluminum and copper materials have quite different physical properties, making it difficult to achieve a tight and reliable connection. Therefore the main problem to resolve before aluminum can replace copper is achieving an effective connection between both the aluminum and copper tubing. Currently, blaze welding connection techniques can resolve this issue, however, the use of blazing filler material and flux is a risk to both the environment and the operator. Other shortcomings include requiring high temperature, high pressure, and low work efficiency, thus making said conventional blaze welding methods unable to be widely adapted.

[Content of the Invention]

The present invention provides an expansion blaze welding method of aluminum copper tubing, an active bonding agent for said method, and the preparation method thereof so that the active bonding agent without blazing filler material provides an appropriate amount of adhesion and stability to ensure a quicker blaze welding processing. It produces little stress, requires a low temperature, and only needs a low pressure. The active bonding agent without blazing filler material of the present invention includes the following components: an activated nanopowder, a non-corrosive flux, and a binder. The weight ratio relationship between each components is: binder : non-corrosive flux : activated nanopowder

= (1 - 20) : (1 - 5) : (0 - 1). Of which, the purity of the activated nanopowder is 99.9% - 100% and the granularity is 20 nm - 100  $\mu\text{m}$ . Its properties are optimal when a granularity of 20 nm - 10  $\mu\text{m}$  is used for the nanopowder to form the bonding agent. The binder is comprised of water and organic cellulose, and the weight ratio of the water and the organic cellulose is 100 : (0.1 - 5). The preparation method of the active bonding agent without blazing filler material is: The activated granules with a purity of 99.9% - 100% are mechanically smashed or power-sprayed to form a nanopowder with a granularity of 20 nm - 100  $\mu\text{m}$ . A binder is composed of water and organic cellulose. The weight ratio of the water and organic cellulose is 100 : (0.1 - 5). Mix the aforementioned two components with a non-corrosive flux according to the following weight ratio relationship: binder : non-corrosive flux : activated nanopowder = (1 - 20) : (1 - 5) : (0 - 1) to form an active bonding agent without blazing filler material.

The rapid expansion blaze welding method for the aluminum copper connection piping of the present invention is: First process the connector of the aluminum pipe 1 and copper pipe 2 into a cone 3. The blaze welding surface of the cone 3 of the aluminum pipe 1 and copper pipe 2 connector is coated with an active bonding agent without blazing filler material 4. It is /4 then heated according to the blaze welding temperature of the specification. During the process of heating, a pressure of P is applied to the two ends of the two welding pipes so that a tight connection is maintained throughout, during the blaze welding process between the aluminum pipe 1 and copper pipe 2 to complete the rapid blaze welding process. When heating, the difference in the linear expansion coefficient of the aluminum copper

will cause a tight connection to be maintained between the aluminum pipe 1 and copper pipe 2. And, a connection pressure will be generated between the blaze welding surfaces. When the aluminum pipe 1 is inserted inside the copper pipe 2, the aluminum pipe 1 and copper pipe 2 connectors are not processed into cones and are directly blaze welded. When heating, the heat expansion coefficient of the aluminum is greater than the heat expansion coefficient of the copper and a connection pressure is generated between the aluminum pipe 1 and copper pipe 2 to achieve a connection reaction blaze weld. In addition, reduction processing can be performed on the copper pipe 2 after completing the connection, whereby the blaze welding is then performed to strengthen the tight connection between the aluminum pipe 1 and copper pipe 2. The activated binder without blazing filler material of the present invention provides an appropriate level of bonding which can be stored long-term and will not react with any other component. It can be welded to different metals and non-metals. The generated stress is low, the weld temperature is low, the stress is low, and the requirements for the environment and sample surfaces are not great. The activated binder without blazing filler material can use a coating such as a brush-on, spray, or dip technique on the connection surface of the part awaiting welding. The heating method can include torch heating, induction heating, and electric arc furnace methods. The activated nanopowder will react with the aluminum pipe and copper pipe at a specific temperature to form a new type of alloy between the aluminum pipe and copper pipe. The flux plays a part in achieving a specific heating temperature to remove the oxides and pollutants from the surface of the

aluminum pipe and copper pipe. Comparing the rapid blaze welding method of the present invention to common blaze welding methods shows a tighter connection between the aluminum and copper materials with a blaze joint densification reaching 85% or more. In addition, the blaze welding technique is simplified and low cost. The cost reduction of replacing copper materials with aluminum is 50%, for a total cost reduction of 35%.

Description of the Diagrams: Figure 1 is a structural diagram of the connection of the aluminum pipe 1 and the copper pipe 2 in Preferred Embodiment 4. Figure 2 is a structural diagram of the connection of the copper pipe 2 and aluminum pipe 1 in Preferred Embodiment 5. Figure 3 is a structural diagram of the connection of the copper pipe 2 and aluminum pipe 1 in Preferred Embodiment 6. Figure 4 is a structural diagram of the connection of the aluminum pipe 1 and the copper pipe 2 in Preferred Embodiment 7.

#### [Preferred Embodiment 1]

The active bonding agent without blazing filler material of this preferred embodiment is composed of activated nanopowder, a non-corrosive flux, and a binder. The weight ratio relationship of these components is: binder : non-corrosive flux : activated nanopowder = (1 - 20) : (1 - 2) : (0.1 - 0.4). Of which, the purity of the activated nanopowder is 99.90 - 99.93% and the granularity thereof is 20 nm - 10 µm. The binder is composed of water and organic cellulose. The weight ratio of the water and organic cellulose is 100 : (0.5 - 3).

[Preferred Embodiment 2]

The difference between this preferred embodiment and Preferred Embodiment 1 is the purity of the activated nanopowder is 99.93 – 99.96%, and the granularity thereof is 11 nm – 30 µm. The weight ratio of each component of the active bonding agent without blazing filler material is: binder : non-corrosive flux : activated nanopowder = (1 – 20) : (2 – 4) : (0.5 – 0.8). /5

[Preferred Embodiment 3]

The difference between this preferred embodiment with Preferred Embodiment 1 and 2 is the purity of the activated nanopowder is 99.96 – 99.99%, and the granularity thereof is 31 nm – 60 µm. The weight ratio of each component of the active bonding agent without blazing filler material is: binder : non-corrosive flux : activated nanopowder = (1 – 20) : (4 – 5) : (0.8 – 1).

[Preferred Embodiment 4]

The rapid blaze welding method of the aluminum and copper pipe connection of this preferred embodiment is: first, process the blaze welding surface 3 of connector of the aluminum pipe 1 and copper pipe 2 into a single cone 3-1 so that the aluminum pipe 1 is on the inside and the copper pipe 2 is on the outside. An active bonding agent without blazing filler material 4 is sprayed on the blaze welding surface. It is then heated according to the blaze welding temperature of the specification. During heating, a pressure of P is applied to the two ends of the two welding pipes so that a tight connection is maintained throughout,

during the blaze welding process between the aluminum pipe 1 and copper pipe 2 to complete the rapid blaze welding process.

[Preferred Embodiment 5]

The difference between this preferred embodiment and Preferred Embodiment 4 is the copper pipe 2 is on the inside and the aluminum pipe 1 is on the outside. The other processes are the same as Preferred Embodiment 4.

[Preferred Embodiment 6]

The difference between this preferred embodiment and Preferred Embodiment 4 is the blaze weld surface of the connector is processed into a double cone surface 3-2. The other processes are the same as Preferred Embodiment 4 and 5.

[Preferred Embodiment 7]

The difference between this preferred embodiment and Preferred Embodiment 4 is when the aluminum pipe 1 is inserted into the copper pipe 2, the connectors of the aluminum pipe 1 and copper pipe 2 are not processed into a cone surface and they are directly blaze welded.

[Preferred Embodiment 8]

The difference between this preferred embodiment and Preferred Embodiment 7 is that there can still be a reduction processing step performed on the copper pipe 2 after the connection is complete, before performing the blaze welding.

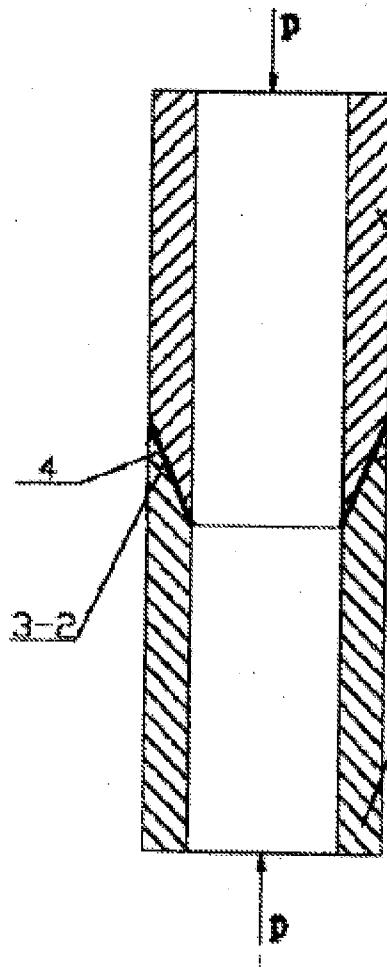


Figure 1

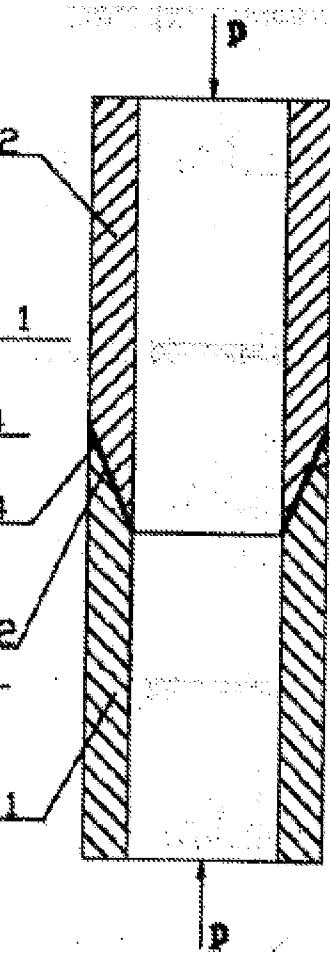


Figure 2

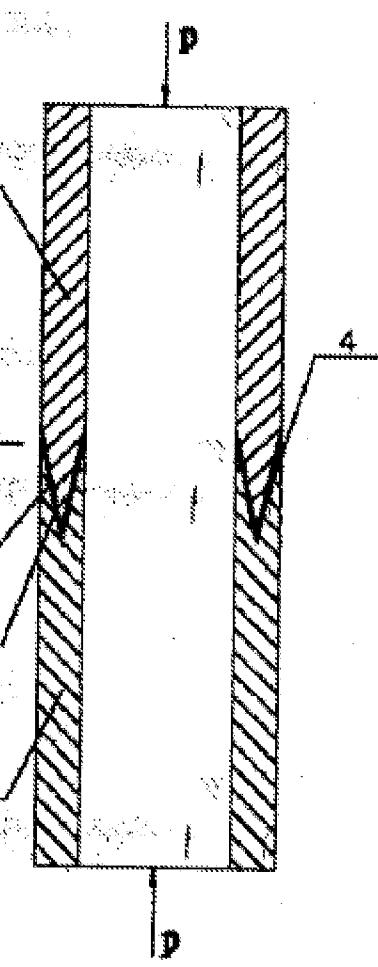


Figure 3

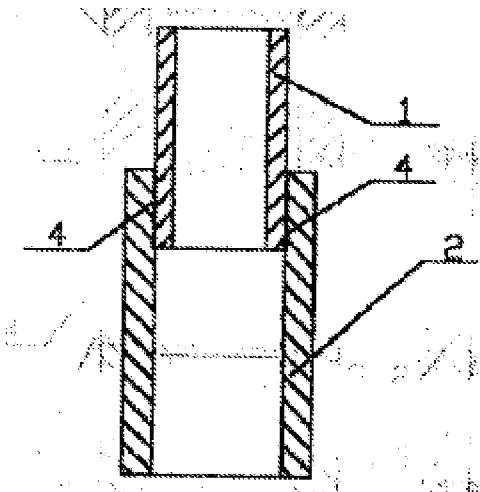


Figure 4